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WATER-POWER.

An Outline of the Development and Application of the Energy of Flowing Water. By Joseph P. Frizell. Pp. vii + 563. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1901.)

WATER-POWER, as developed in waterfalls, has been brought prominently into notice in recent years as an important source of power, owing to the facilities afforded by electricity of transmitting it to a distance; so that a small portion of the Niagara Falls and numerous minor falls have been utilised for supplying power economically for electric lighting, traction, and other purposes, to places many miles distant from the falls. The author, however, of this volume desires to direct attention to the more widespread sources of water-power contained in streams and rivers, which can be utilised either by taking advantage of the natural fall by means of suitable works, or by storing up the flow in flood-time in reservoirs formed by constructing dams across the higher parts of river valleys; and the water thus collected can be converted directly into power by using the available fall below the dam, which, however, is reduced in proportion as the water-level of the reservoir is lowered, or it can be employed in supplementing the discharge of the river below the dam during its low stage, so that the flow when used for driving hydraulic motors may never fall below a definite volume. The author points out that whereas in recent times water-power has been to a great extent superseded by steam-power, owing to the cheapness of fuel and improvements in steam engines, timber has already become much less plentiful in the United States, and even coal will in time be exhausted; whilst the sources of water-power will always remain, and have already become more available by the adoption of electrical transmission, which in its turn has led to many notable developments and improvements in the utilisation of power. Undoubtedly vast sources of power produced by the sun's heat are continually running to waste in rivers and streams, as evidenced by the estimate quoted by the author, that the power derivable from the St. Lawrence and its tributaries is nearly equal to that obtainable from all the coal raised yearly in the United States. The difficulty consists in rendering this power economically available, for a high fall and a regular flow furnish the most efficient source of water-power; whereas the fall of rivers is, for the most part, moderate and spread over long distances, and their flow very variable, more especially in the upper part of their course, where the fall is the greatest. It is, therefore, quite natural that waterfalls have been resorted to as a source of water-power, and for transmission to a distance, especially where they occur at some distance from the source of a river, and consequently possess a more regular flow; whereas the utilisation of the more ordinary flow of rivers, except for local purposes, seems destined to have to wait till a considerable increase in the price of fuel and the absorption of the most advantageous sources of water-power render it necessary to turn to less economical supplies. Where a river has a rapid fall for a considerable distance, it may be quite practicable to develop largely its available water-power, by regulating its flow by the construction of a reservoir by means of a dam of moderate height across the upper part of its valley, so as to render its discharge always adequate to actuate turbines placed at suitable points along its course.

After an introductory chapter upon natural water-courses, including a computation of the *flowage*, or raising of the surface and modification of the slope of a stream by a dam put across it, the author treats of the various forms of dams constructed across rivers and streams, in ten chapters extending over 209 pages, embracing in his descriptions fixed weirs and some forms of movable weirs, as well as earthen and masonry reservoir dams, with their methods of construction and some notable failures. Such works, considered here as applicable to the development of water-power, constitute essential constructions for the improvement of rivers for navigation, and for forming storage reservoirs for the water-supply of towns, which have been often described in books and papers relating to these branches of hydraulic engineering; and the author only enters in the latter half of his book upon the consideration of hydraulic motors, and the modes of transmission of the power thus obtained, which more specially appertain to his subject. Three chapters are devoted to the methods of conveying the water to the motors, and the arrangements for the regulation of the supply and the power; whilst the various forms of water-wheels and of turbines are described in two consecutive chapters. Some instances are next given of the utilisation of natural water-powers in the United States; and it is pointed out that the plan formerly sometimes adopted of dividing a considerable fall into two or three parts, so as to command a large area of ground for the mills, is an expensive system in regard to the motors, and wasteful of the power, and that with modern methods of distribution it is expedient to make use of the entire head. The most important and special part of the book, however, is contained in the following five chapters, in which the various methods resorted to for the transmission of power are considered, and some interesting examples of notable power-houses are described. The forms of transmission dealt with are shafting and wire ropes, hydraulic transmission, transmission by compressed air, and electrical transmission. All these methods of transmission and distribution of power have their respective utility, but they differ considerably in the distance to which they can act with efficiency. Thus shafting is useful for transmitting power throughout a mill or manufactory; but beyond three or four hundred feet wire ropes are more economical, and can be employed with advantage up to about a mile. Hydraulic transmission is valuable in storing up power for intermittent working, as required at docks and large canal locks; but its efficiency for driving machines at a distance of about a mile is only 50 per cent. Air compressed by means of water-power has been transmitted considerable distances for boring the headings of long alpine tunnels, which it has also served to ventilate; and compressed air has been used for the transmission of power in a mine in the United States to a distance of three miles; but the changes of temperature produced in the compression and expansion of the air

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necessitate special arrangements to avoid considerable loss of efficiency. Electrical transmission, the most modern and most effective method of utilising power at a distance from the place where it is generated, has notably augmented the value of the water-power of falls; for it has enabled the power-house to be established at the source of the power, and the power developed to be distributed to manufactories situated in the most convenient localities, far removed from the generating station. Thus the Telluride Power Transmission Company, at Provo, in Utah, transmits 2000 h.p. by electricity a distance of 55 miles, at the high voltage of 40,000 volts; whilst the Southern California Power Company, possessing a head of water of 750 feet at Santa Ana Canyon near Redlands, develops 4000 h.p., and obtaining a current at 750 volts transforms it to 33,000 volts and transmits it 80 miles to Los Angeles. In the chapter on "The Power-House," the general arrangements of such establishments are explained, and the power-houses at Lachine Rapids, on the St. Lawrence, at Mechanicsville, on the Hudson 18 miles above Albany, and at Sault Sainte Marie, on the rapids between Lake Superior and Lake Huron, are described.

The book is illustrated by two hundred and thirty-two drawings, sections and diagrams, distributed throughout the text, and is furnished with an index; but it does not contain any tables of contents of the twenty-five chapters, beyond a short title at the head of each, or any list of the illustrations. The materials for the volume have been, to a large extent, collected from the most noteworthy records of engineering societies and pages of engineering journals, as well as from plans of works carried out; and the principles involved and the results aimed at have been presented in a condensed and readable form. The book should prove useful in directing attention to the enhanced value of water-power, especially in view of the very important assistance afforded it by electrical transmission.

AN ANGLO-AMERICAN WORK ON THE MARKET GARDEN.

The Principles of Vegetable Gardening. By L. H. Bailey. Pp. x+458. (London: Macmillan and Co. Ltd., 1901.) Price 4*s.* 6*d.* net.

THIS work is one of a "Rural Science Series," edited by an American author, but it is by no means the best. Its principal fault is that in covering too much ground it fails to treat with thoroughness the numerous subjects which are included in the seven chapters described in the table of contents. The most important of these subjects are "The Soil and its Treatment," "Glass" in relation to glass culture, "Seeds and Seedage," the last a word quite new to the industry in England, the meaning of which is not absolutely clear, and "The Management of the Vegetable Garden."

In market garden culture success depends upon approximate perfection in the soil, the seed and the management; for the realisation of profit a further qualification must be added—marketing. Nor does the arrangement of the chapter simplify matters; a number of quotations from other authors, printed in small type, are introduced in order to show the reader what soil to select, but while these authorities do not absolutely agree, the majority select a deep sandy loam. Such a soil may be found under garden cultivation in Bedfordshire and in the potato growing districts of the Vale of York, but before a clay loam with a clay subsoil is condemned the reader should see farm gardening on the London clay and in the Lea Valley.

A large proportion of this important chapter is devoted to "Fertilisers," but stable manure, which is the foundation of early as of heavy crops, and of double and triple crops, is barely mentioned; indeed, excepting in a brief reference to the preparation of hot beds under glass, stable manure is absolutely unmentioned in the copious index. We remember, on visiting the extensive gardens attached to the great experiment station of New York State at Geneva, being informed how much the management owed to an English gardener. The editor of this work would have largely added to its value had he interviewed such a man, or an English market gardener of eminence.

The subject of "Seeds" is more fully treated, but in the whole 50 pages the details for which the practitioner will look are in large part conspicuously absent. The chapter is largely composed of useful figures drawn from the reports of experiment stations, but it has no very direct bearing upon the gardening industry. Nor can we speak more highly of the treatment of the next essential subject, "Management," which might be better arranged and which is abundantly fortified with quotations; there is, indeed, much that is useful, but if a grower seeks advice of a practical character he will not always find it. At the end of the chapter there are some recommendations which are intended to help the gardener to preserve his crops from the attacks of insects and fungi; but when we say that the most destructive of all soil insects, the wire worm, *Elater sp.*, is dismissed in half a dozen lines, we do not misrepresent the extent of the information. The gardener is wisely recommended to make Paris green into a paste, but in this country it is not sold in any other form.

The second part of the book, in which crops are discussed in greater detail, is much better arranged, although the author has adopted a form of classification which, if ingenious, has its difficulties. He groups the plants of the vegetable garden as roots, tubers, bulbs, salads, pulse, solanaceous crops and so on, but this arrangement is quite unscientific; the turnips and the beet, for example, classed as roots, are bulbs, while the potato, if a tuber, is also a member of the solanaceæ. Again, cabbages and the cauliflower are classed as cole crops, but both belong to the same family as the radish and rutabaga or swede turnip, both of which are classed as roots. Here we notice a curious error: "The rutabaga (is) known in England as Swedish turnip and turnip rooted cabbage, and in French as Chou navet." The French equivalent for swede, which is unknown in England as turnip rooted cabbage, is rutabaga. Let us add that although many of the illustrations are exceptionally good, that intended to represent the turnip is ludicrous as applied to the improved plant.

This part of the work is, however, by far the best, treating as it does of many plants peculiar to the United States, as well as of those common to the

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